# Bacteria TMDL in the Piney Run Watershed

First Public Meeting

December 18, 2003

# Presentation Overview

1. **Overview of Virginia's TMDL Program**
2. Applicable Water Quality Standard
3. Piney Run Impairment
4. TMDL Development Approach
5. Bacteria Source Assessment

# What is a TMDL ?

- TMDL stands for **Total Maximum Daily Load**
- A TMDL is a **pollution budget**
- A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet **water quality standards**
- A TMDL includes an **allocation** of that maximum amount to the pollutant's sources

# TMDL Equation

A TMDL is summarized as:

**TMDL = Sum of WLA + Sum of LA + MOS**

Where:

- TMDL = Total Maximum Daily Load
- WLA = Waste Load Allocation (point sources)
- LA = Load Allocation (nonpoint sources)
- MOS = Margin of Safety

# How is a TMDL developed?

- Identify all sources of a given pollutant within the watershed
- Calculate the amount of pollutant entering the stream from each source
- Calculate the pollutant reductions needed, by source, to attain water quality standards
- Allocate the allowable loading to each source and include a margin of safety

# When are TMDLs needed?

- State and federal law require TMDLs to be developed for **impaired** waters
- Impaired waters do not meet applicable **water quality standards** (WQS)
- Waters that do not meet WQS do not support their **designated use(s)**
- For bacteria impairments, the designated use that is affected is the **recreational use**

# Regulatory Basis of TMDLs

- TMDLs required by Federal and State law
  - 1972 Clean Water Act (CWA), Section 303(d)
  - 1997 Water Quality Monitoring, Information and Restoration Act (WQMIRA)
- 1998 lawsuit filed by the American Canoe Association and the American Littoral Society against EPA for failure to comply with CWA §303(d) in Virginia
- 1999 Consent Decree requiring EPA and Virginia to complete 636 TMDLs by 2010

# Regulatory Requirements

- Both state and federal law require:
  - Establishment of water quality standards
  - Monitoring of water quality in surface waters
  - Assessment of water quality in surface waters
  - Listing of waters that do not meet water quality standards (impaired waters)
  - Development of TMDLs for impaired waters
- State law requires, and federal law recommends:
  - Development of a TMDL Implementation Plan

# Roles of DEQ and DCR in TMDL and IP Development

- DEQ is the lead for TMDL development, including submittal to EPA
- DCR is the lead for TMDL Implementation Plan (IP) development
- DEQ is responsible for ensuring public participation in the TMDL program

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# Water Quality Standards

- Water Quality Standards (WQS):
  - set by states and approved by EPA
  - set **numeric** and **narrative** limits on pollutants
  - consist of **designated use(s)** and water quality **criteria**
- Purpose of WQS:
  - **protection** of 5 designated uses (aquatic life, fish consumption, shellfish, recreation, drinking water)
  - **restoration** of state waters to meet criteria

# Applicable Designated Use

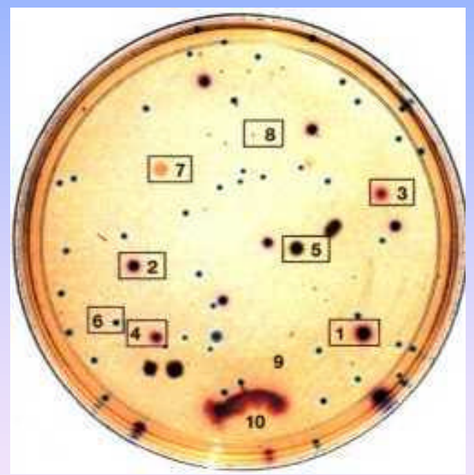
- All surface waters in Virginia are currently designated for **primary contact recreation** (e.g. swimming)
- In March 2003, a **secondary contact recreation** use designation (e.g. wading, fishing) was added to the WQS
  - Five times the primary contact criteria
  - Individual waters will only be considered for reclassification after TMDL implementation has been tried using reasonable BMPs
  - Effective date pending EPA approval

# Pollutant of Concern

- ***Fecal bacteria*** are found in the digestive tract of humans and warm blooded animals
- Fecal bacteria are an indicator of the potential **presence of pathogens** in waterbodies
- The presence of fecal bacteria in water samples is a strong indicator of recent **sewage or animal waste contamination**

# Sampling for Bacteria

- Stream samples are collected in sterile 125 mL sample bottles
- Samples are filtered to deposit bacteria on filters
- Filters are incubated, allowing individual bacteria to grow into visible colonies
- Colonies are counted to give a concentration of colony forming units (cfu) per 100 mL



# Old Criteria

- Indicator species: **fecal coliform**
  - used in listing Piney Run
- **Instantaneous max**: **1,000 cfu/100 mL**
  - Applicable for data sets with 1 or fewer samples in 30 days
- **Geometric mean: 200 cfu/100 mL**
  - Applicable for data sets with 2 or more samples in 30 days

# New Criteria

- Indicator species for freshwater: ***E. coli***
  - change in indicator species from fecal coliform to ***E. coli*** (fresh water)
  - *E. coli* bacteria are a **subset of fecal coliform** bacteria and correlate better with swimming-associated illness

- **Instantaneous max**: **235 cfu/100 mL**
- Applicable for all data sets; no samples may exceed the maximum

- **Geometric mean: 126 cfu/100 mL**
- Applicable for data sets with 2 or more samples in a calendar month

# Summary of Changes in Primary Contact Criteria

| Indicator | Status | Instantaneous Maximum (cfu/100mL) | Geometric Mean (cfu/100 mL) |
|---|---|---|---|
| Fecal Coliform | Old | 1,000 | 200 |
| *E. coli* | New | 235 | 126 |
| Fecal Coliform | Interim | 400 | 200 |

- Changes went into effect on January 15, 2003
- Both New *E. coli* and Interim Fecal Coliform criteria apply
- Fecal coliform criteria will be phased out entirely once 12 *E. coli* samples have been collected or after June 30, 2008

# Comparison of the Old Fecal Coliform and New *E. coli* Criteria

| Old FC (cfu/100mL) | Interim FC (cfu/100mL) | FC translated to EC* (cfu/100mL) | New EC (cfu/100mL) |
|---|---|---|---|
| 200 | 200 | 129 | 126 |
| | 400 | 243 | 235 |
| 1,000 | | 565 | |

* Based on regression model between 493 dual data points

Note: FC = Fecal Coliform, EC = *Escherichia Coli*

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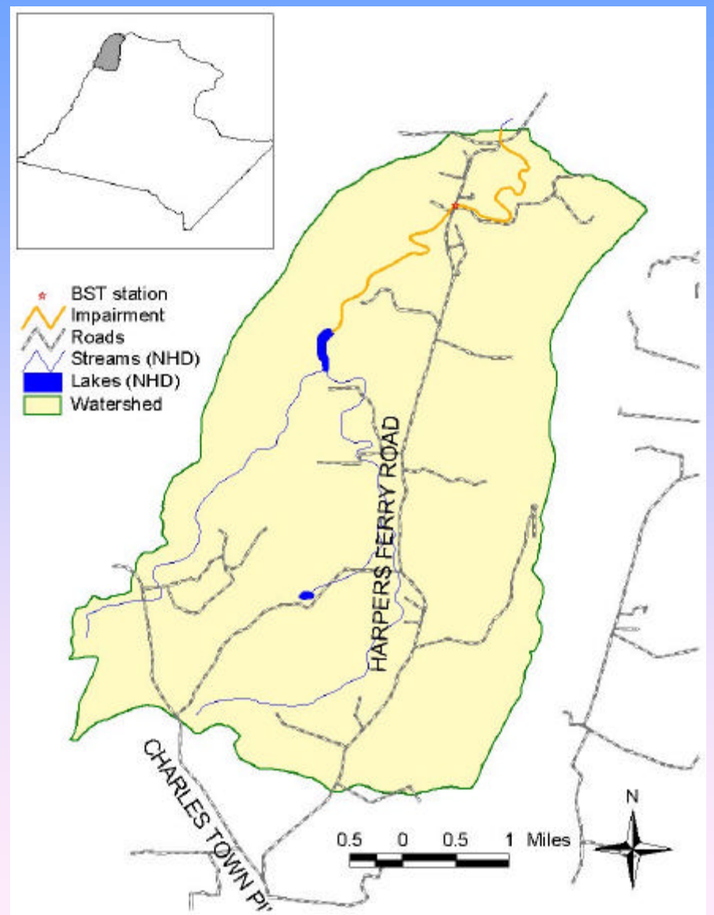
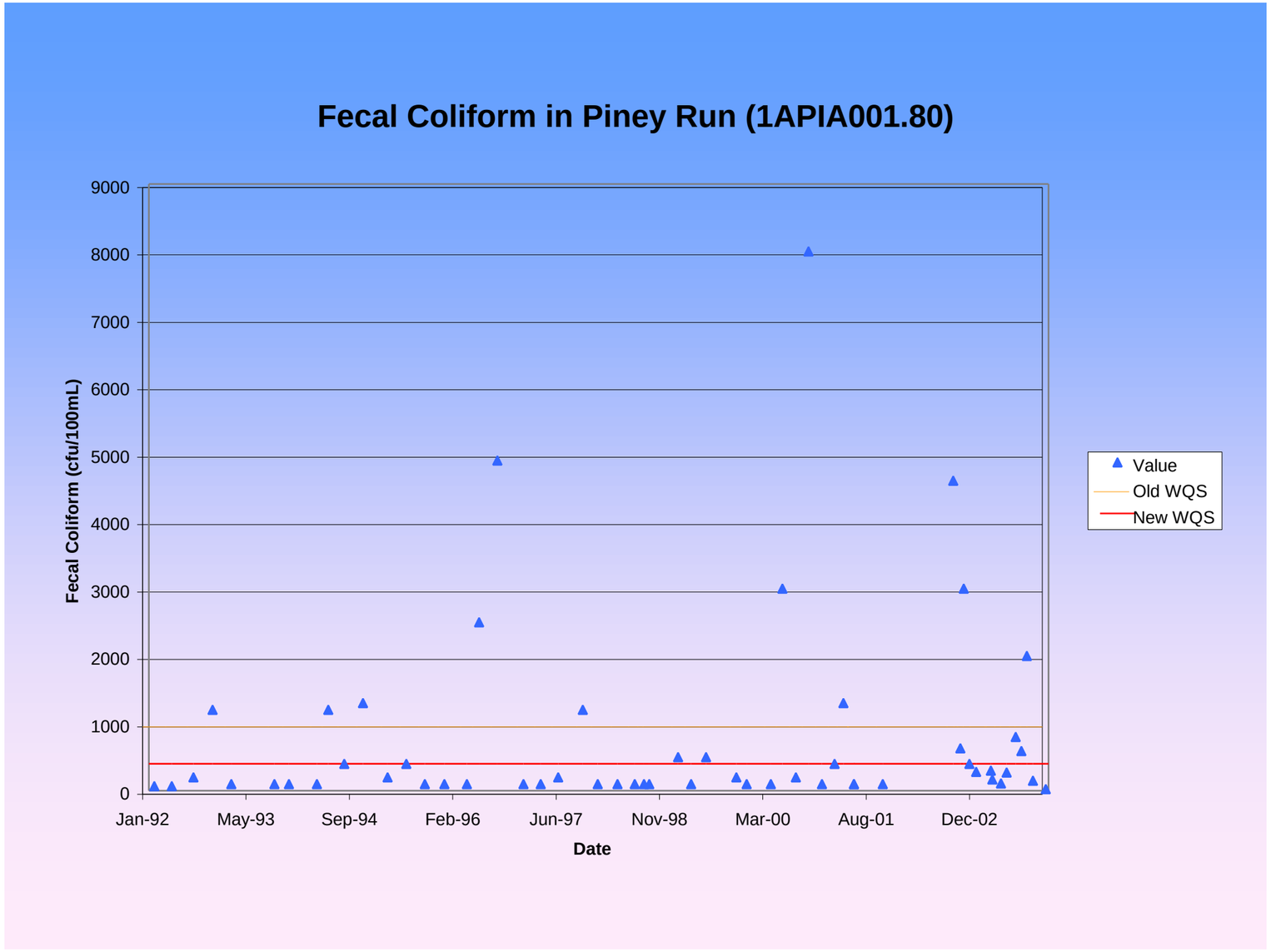
# Impairment in the Piney Run Watershed

| WATER BODY | CAUSE | STREAM NAME | LENGTH (Miles) | YEARS LISTED |
|---|---|---|---|---|
| VAN-A01R | Bacteria | Piney Run (from mouth of unnamed lake to confluence with Potomac River) | 3.52 | 1998, 2002 |

# Map of the Piney Run Watershed




- DEQ monitoring station: 1APIA001.80
- USGS flow gage: 01636690
- 2002 305(b) results: 5 of 22 samples (23%) exceeding 1000 cfu/100mL
- 2000 305(b) results: 5 of 20 (25%)
- 1998 305(b) results: 5 of 19 (26%)


Fecal Coliform in Piney Run (1APIA001.80)
Fecal Coliform (cfu/100mL)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Jan-92
May-93
Sep-94
Feb-96
Jun-97
Nov-98
Mar-00
Aug-01
Dec-02
Date
Value
Old WQS
New WQS

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# What is Load Duration Analysis?

- Less complex spreadsheet model for TMDL development
- Approach proposed for bacteria TMDLs in small watersheds
- Model requires
  - stream flow data
  - ambient water quality data, and
  - bacteria source tracking data (for pollutant source identification and loading allocations)

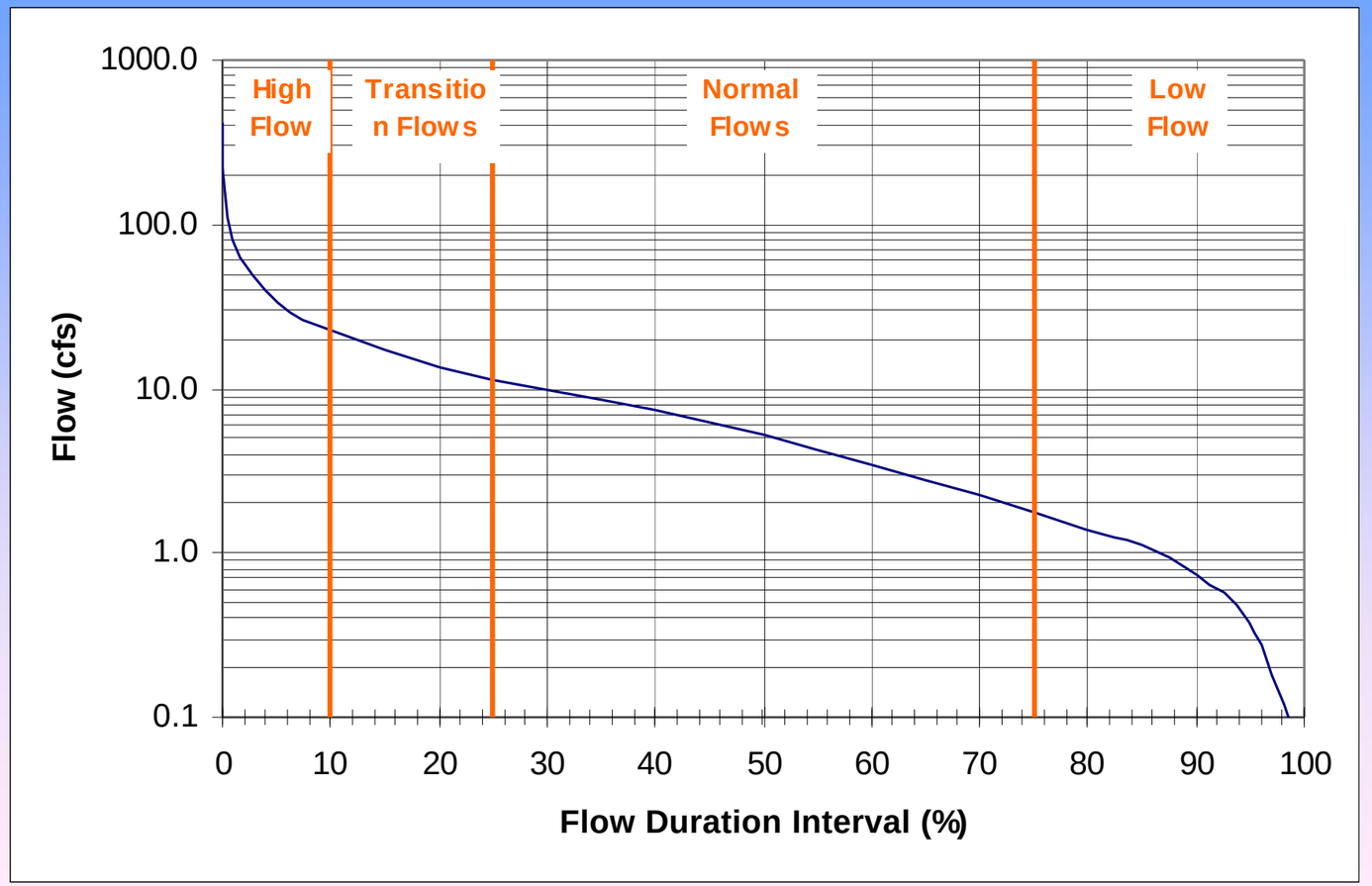
# Development of Flow Duration Curve for Piney Run

- Piney Run has a USGS flow gaging station that was established in 2001
- In order to include the time period that led to the listing (1/1/1996 to 12/31/2000 for the most recent assessment), the flow record must be extended

# Reference Stream Selection

- Flows were correlated with Catoctin, Goose and Passage Creeks
- The period from 1988 to present was used
- Piney Run flows correlated best with Catoctin Creek (0.9317)
- Flow regression equations were then used to generate continuous flow records (1988-03)

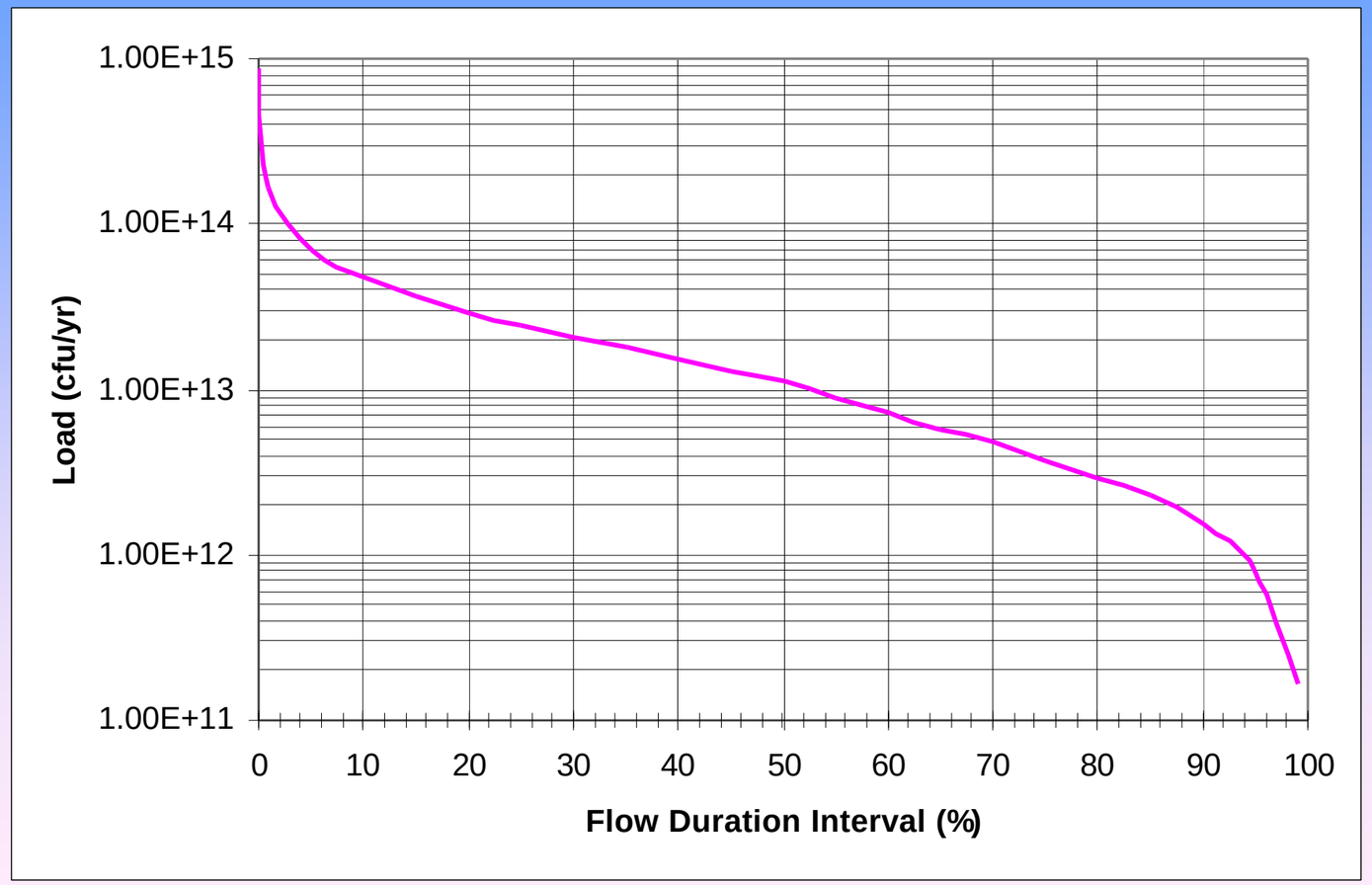
# Piney Run Flow Duration Curve



# Load Duration Curve

- Represents the maximum amount of a pollutant allowed at each flow level
- Obtained by multiplying the flow duration curve by the water quality criterion
- At higher flows, a stream will have more assimilative capacity
- At lower flows, it will have less assimilative capacity

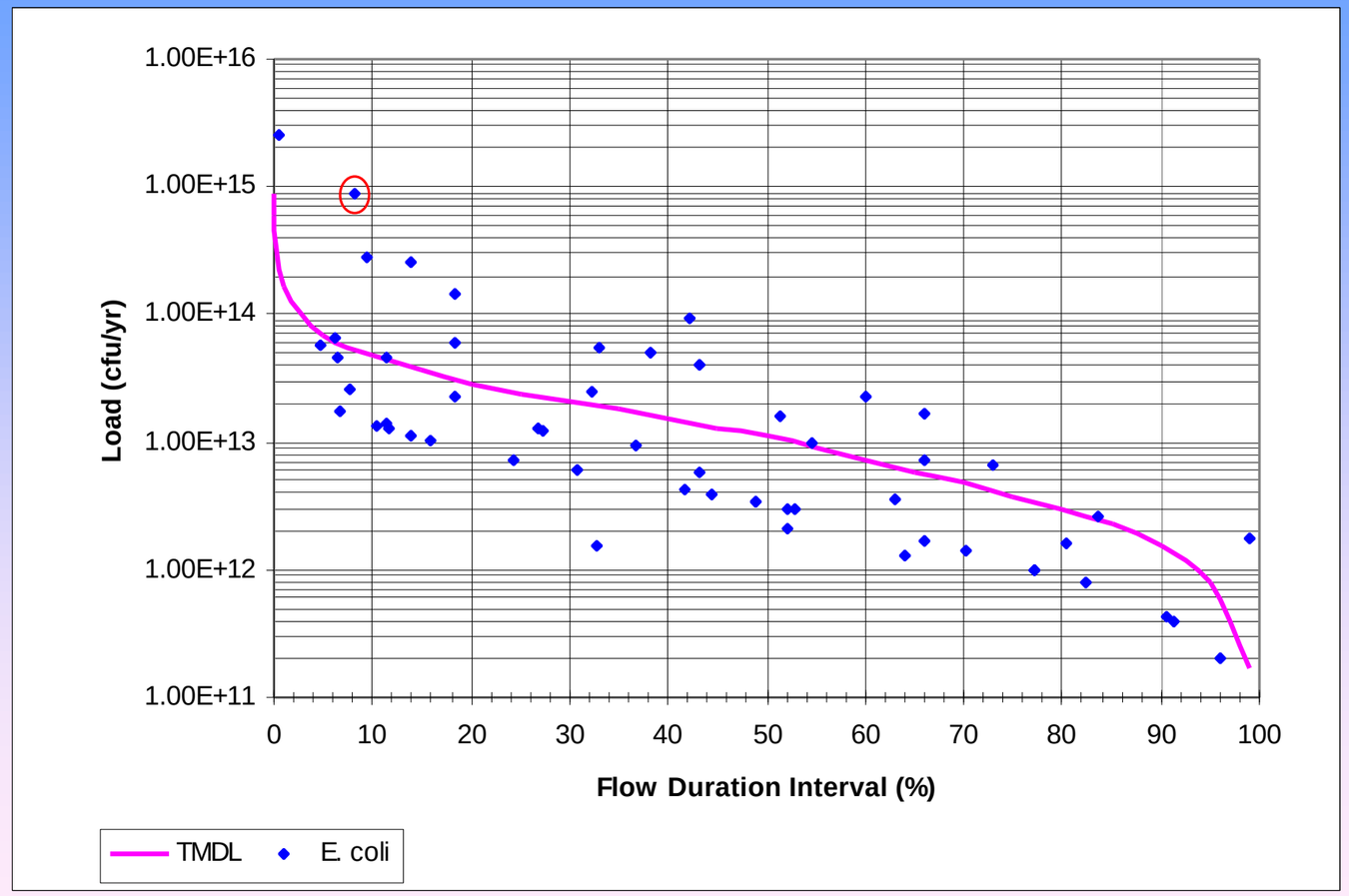
# Piney Run Load Duration Curve



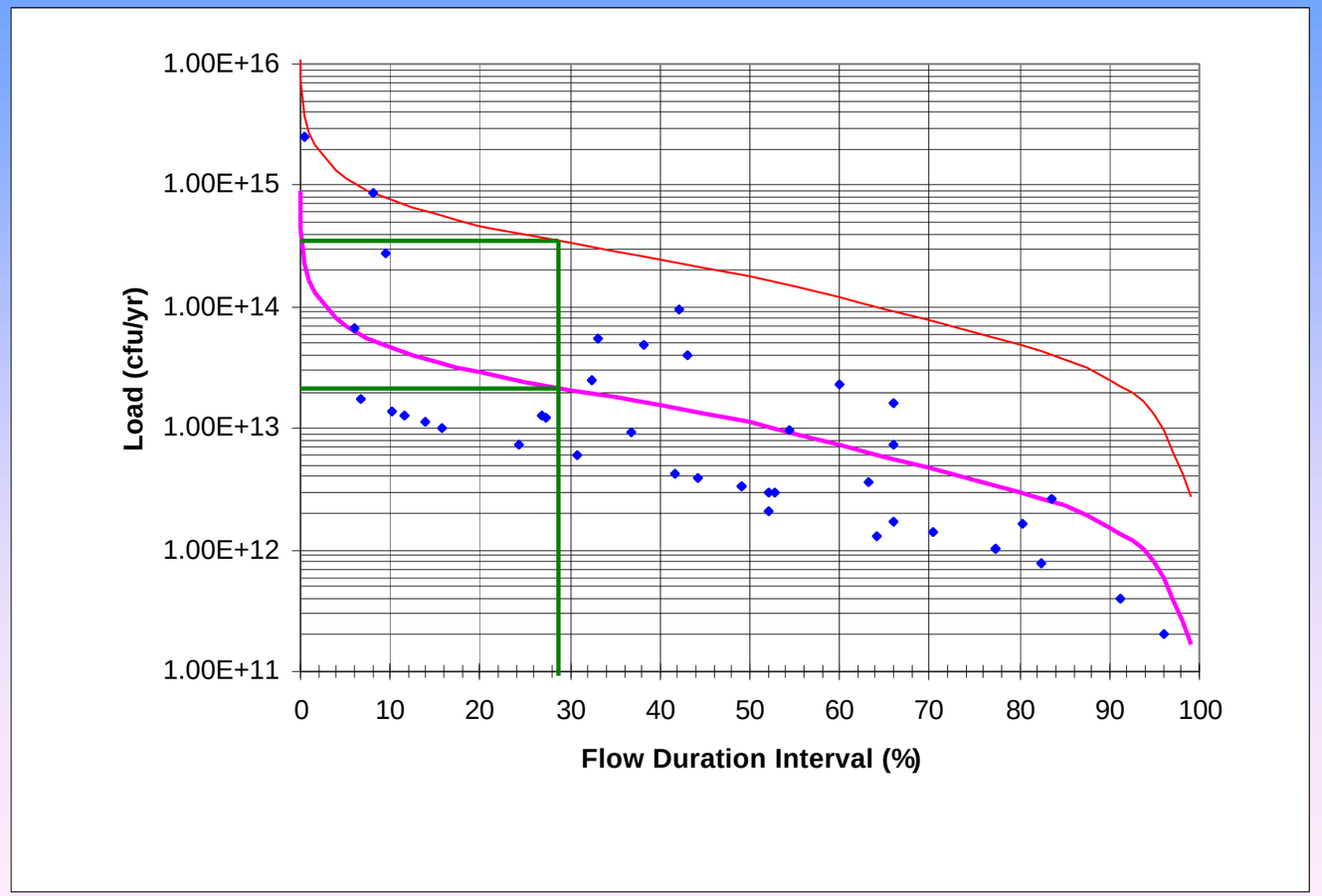
# TMDL Required Reduction

- The TMDL must ensure water quality is protected during times when stream is most vulnerable
- The stream is assumed to be most vulnerable when the highest exceedance occurs
- This critical condition occurred on 9/26/2000, with an observed concentration of 3,819 cfu/100mL at an estimated flow of 25.72 cfs

# Piney Run Load Duration Curve



# Piney Run TMDL



# TMDL Reduction Required

- The TMDL equation is then calculated using the maximum observed exceedance and average flow conditions (10.23 cfs)
- At average flow:
  - the existing load is $3.49 \times 10^{14}$ cfu/yr
  - the allowable load is $2.15 \times 10^{13}$ cfu/yr
  - the required reduction is $3.28 \times 10^{14}$ cfu/yr
- This corresponds to a 94% reduction

# Development of TMDL Allocations

- Assume an implicit margin of safety due to conservative assumptions
- Subtract point source loads from the TMDL load to obtain the non-point source load
- Use results of source assessment and BST study to allocate the non-point source loads among sources (human, livestock, wildlife)

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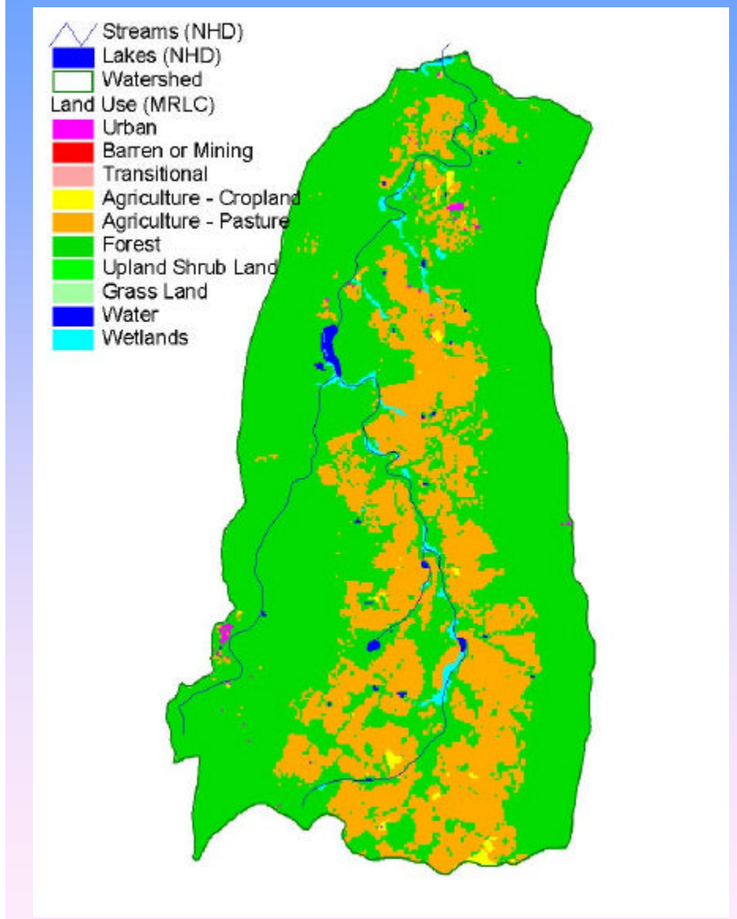
# Land Use in the Piney Run Watershed

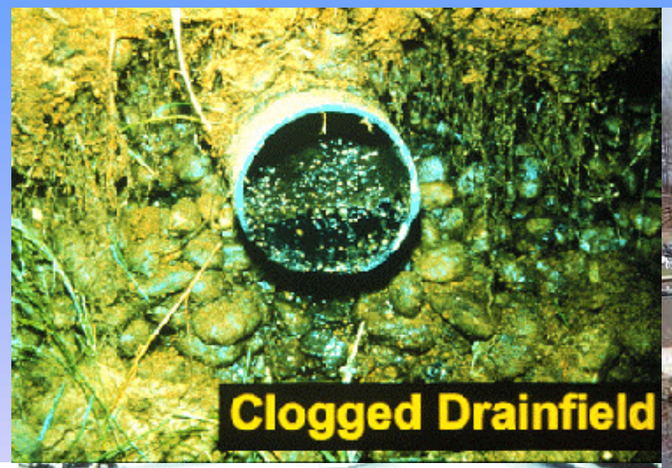



| MRLC Land Use | Piney Run | |
|---|---|---|
| | Acres | Percent |
| Cropland | 48 | 0.5% |
| Pasture | 2,616 | 26.9% |
| Barren or Mining | 0 | 0.0% |
| Forest | 6,908 | 71.0% |
| Transitional | 1 | 0.0% |
| Urban | 20 | 0.2% |
| Water | 36 | 0.4% |
| Wetlands | 104 | 1.1% |
| Total | 9,731 | 100.0% |

# Potential Sources of Bacteria in Piney Run

- Humans/Pets
  - Straight Pipes
  - Septic Systems
  - Biosolids
  - Permitted Point Sources
  - Pets
- Livestock
  - Direct Deposit to Land and Streams
  - Land Application
- Wildlife
  - Direct Deposit to Land and Streams

# Potential Human and Pet Sources





# Estimated Human and Pet Sources

| Source | Piney Run | Reference |
|---|---|---|
| People | 626 | 2000 Census |
| Dogs | 411 | 2000 Census, APPMA |
| VPDES Permits | 0 | VADEQ |
| SFH Permits | 2 | VADEQ |
| Septic Systems | TBD | Loudoun Co. Health Dept. |
| Straight Pipes | TBD | Loudoun Co. Health Dept. |
| Biosolids | TBD | Loudoun Co. Health Dept. |

| Watershed | Permit No. | Facility Name | Design Flow |
|---|---|---|---|
| Piney Run | VAG406106 | Neersville Volunteer Fire and Rescue | 400 gal/day |
| Piney Run | VAG406249 | Amoco - Tri State | 875 gal/day |

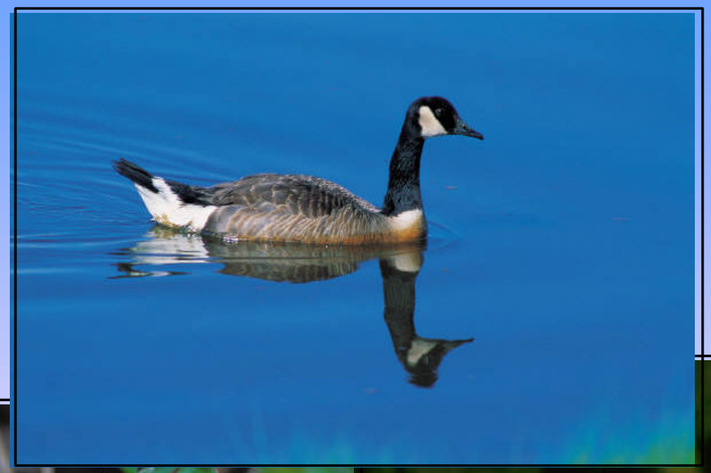
# Potential Livestock Sources

# Estimated Livestock Sources

| Source | Piney Run | Reference |
|---|---|---|
| Cattle and calves | 500 | 1997 Ag Census/Loudoun SWCD |
| Beef Cows | 225 | 1997 Ag Census/Loudoun SWCD |
| Hogs and Pigs | 0 | 1997 Ag Census/Loudoun SWCD |
| Sheep and Lambs | 30 | 1997 Ag Census/Loudoun SWCD |
| Layers | 50 | 1997 Ag Census/Loudoun SWCD |
| Broilers | 0 | 1997 Ag Census/Loudoun SWCD |
| Horses | 350 | Loudoun SWCD |

- Livestock numbers estimates based on discussion with the Loudoun Soil and Water Conservation District (12/11/2003)

# Potential Wildlife Sources



# Estimated Wildlife Sources

| Animal | Habitat | Density | Piney Run |
|---|---|---|---|
| Deer | Forest, Agriculture, Urban Pervious | 0.084 per acre | 806 |
| Raccoons | Within 600 ft of streams | 0.07 per acre | 119 |
| Muskrats | Within 66 ft of streams | 2.75 per acre | 531 |
| Beavers | Streams | 4.8 per mile | 66 |
| Turkeys | Forest | 0.01 per acre | 69 |
| Ducks | Within 66 ft of streams | 0.008 per acre | 2 |
| Geese | Within 66 ft of streams | 0.02 per acre | 4 |

- Wildlife numbers estimated based on habitat types and animal densities from the Catoctin and Goose Creek bacteria TMDLs

# Bacteria TMDL for the Piney Run Watershed

- First public meeting:
  - Thursday, December 18
    - Neersville Fire and Rescue Building, 11762 Harpers Ferry Road, Hillsboro, Virginia
    - First 30 day comment period ends January 16, 2004
- Second and final public meeting will be held in February 2004
  - Results of BST study
  - Draft report (Second 30 day comment period)
- Submit to EPA for approval

# Bacteria TMDL for the Piney Run Watershed

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# Interim Criteria

- Indicator species: **fecal coliform**
  - will be phased out when 12 *E. coli* observations available or after June 30, 2008, whichever comes first
  - will not be used to assess compliance

- **Instantaneous max**: **400 cfu/100 mL**
  - Applicable for all data sets; no more than 10% of samples in a calendar month may exceed the maximum

- **Geometric mean: 200 cfu/100 mL**
  - Applicable for data sets with 2 or more samples in a calendar month